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## New Nemerteans from Scilly Islands (Great Britain)

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(With 1 plate)

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### Zusammenfassung

In der vorliegenden Arbeit wird die Anatomie und systematische Stellung fünf neuer Nemertinenarten beschrieben. Bei zwei dieser Arten, *Micrura elegans* spec. nov. und *Micrura pseudovaricolor* spec. nov., handelt es sich um Lineidae (Heteronemertini, Anopla). *Tetrastemma angulatus* spec. nov. und *Tetrastemma cruciatus* spec. nov. gehören zur Familie Tetrastemmidae (Hoplonemertini, Enopla), bei *Oerstedtiella crassus* spec. nov. handelt es sich um einen Vertreter der Familie Prosorhochmidae (Hoplonemertini, Enopla). Alle untersuchten Arten stammen vom Küstenbereich vor Scilly Islands (Cornwall, England).

### Summary

Five new nemertean species are described. Two of them, *Micrura pseudovaricolor* spec. nov. and *M. elegans* spec. nov., belong to the heteronemertean family Lineidae. The remaining three species are monostiliferous hoplonemerteans. One of these species, *Oerstedtiella crassus* spec. nov., belongs to the family Prosorhochmidae, the other two, *Tetrastemma cruciatus* spec. nov. and *T. angulatus* spec. nov., belong to the family Tetrastemmidae. All these species come from the Scilly Islands (Cornwall, Great Britain).

### Introduction

Hoplonemertean and heteronemertean systematics have been a vast area of confusion for more than a century (BÜRGER 1895, CANTELL 1975, FRIEDRICH 1935, 1960, GIBSON 1985a, 1988, HYLBOOM 1957). One of the reasons is the inadequate description of many nemertean species.

*Micrura* EHRENBERG, 1831 is one of the largest heteronemertean genera (about 40 described species, GIBSON 1982a). Unfortunately many of these species are only insufficiently known (GIBSON 1982a, see also PUNNETT & COOPER 1909 and FRIEDRICH 1960). Thus, no satisfactory diagnosis of the genus *Micrura* can be given today (CANTELL 1975, FRIEDRICH 1960, GIBSON 1981, 1982a, b).

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The same is true for the genus *Tetrastemma* EHRENBURG, 1831, one of the largest (more than 80 described species) and enigmatic nemertean genera.

In the present paper descriptions of several new nemertean species from the Scilly Islands are given.

### Materials and Methods

The present nemerteans were collected in the Scilly Islands (Cornwall, Great Britain) by Prof. Dr. L. v. SALVINI-PLAWEN and Dr. R. KIKINGER (Vienna, Austria). Beside the material upon which the new species are based, specimens of *Lineus lacteus* RATHKE, 1855 (from French waters, collected by Prof. Dr. J. BIERNE, Reims, France) were studied for comparison with *Micrura elegans* spec. nov.. Specimens of *Oerstedia dorsalis* ABILDGAARD, 1806 (from Danish waters, collected by Dr. L. NIELSEN-BRUNBERG, Copenhagen, Denmark) were studied for comparison with *Oerstedella crassus* spec. nov..

Living specimens were anaesthetized with magnesium-chloride and fixed in formol. Subsequently the animals were embedded in paraffin for serial cross sections (sections were cut at 7  $\mu$ m, complete series). Kernechtrot-Pikroindigokarmin was used as stain.

The material is now lodged with the Naturhistorisches Museum Wien (NHMW), Evertabrata varia Coll., Mikroskopische Präparate-Sammlung; appropriate registration numbers indicated below.

### Heteronemertini SCHULTZE, 1852 - Lineidae MCINTOSH, 1874

#### Genus *Micrura* EHRENBURG, 1831

*Micrura* is a large (40 or more species, GIBSON 1981), but only ill defined genus (CANTELL 1972, FRIEDRICH 1960, GIBSON 1981). GIBSON 1981 advocates the following provisional diagnosis of this genus:

Heteronemertea with a single pair of horizontal lateral cephalic slits, posteriorly enlarged to form wide bays; ciliated cerebral canals emerge from ventral wall of cephalic bays; proboscis unbranched, containing two (outer circular, inner longitudinal) or three (outer longitudinal, middle circular, inner longitudinal) muscle layers and none, one or two muscle crosses; rhynchocoel circular musculature not interwoven with body wall muscles; dorsal fiber core of cerebral ganglia bifurcated only at rear into upper and lower branches; nervous system with neither neurochords nor neurochord cells; ganglionic cell layer of brain usually not separated from body wall muscles by neurilemma; foregut with or without splanchnic musculature, if present variably composed of circular and/or longitudinal fibers; dermis variable, mostly with distinct connective tissue layer separating glandular zone from body wall muscles; caudal cirrus present; cephalic glands normally well developed, occasionally weakly formed or absent; frontal organ usually present; eyes present or absent; sexes separate.

1. *Micrura pseudovaricolor* spec. nov.

**Material:** Holotype: mature female; complete series of cross sections; NHMW: 3225. Paratype: mature female; complete series of cross sections; NHMW: 3226.

**Type locality:** Scilly Islands (Cornwall, England)

**Diagnosis:** The horizontal lateral cephalic slits are not prolonged. Ocelli and frontal organ are present. A caudal cirrus is wanting. Buccal chamber positioned directly behind the cerebral organs. Dermis with few longitudinal muscle fibers, reaching the distal basement layer. Cephalic gland only weakly developed. The rhynchocoel does not extend to the posterior end of the body. The proboscis consists of the same regions and layers as that of *Micrura varicolor* CANTELL, 1975 (CANTELL 1975). Muscle cross overs are present. The foregut nerves are connected by pre- and postoral commissures. The vascular system possesses no cephalic loop. A simple ventral muscle plate is developed, not reaching behind the mouth area. Excretory apparatus with more than one pairs of efferent ducts.

**Description:**

**External characters:** The specimens are at least 4 cm long. In cross section the body is rounded in the foregut region but becomes dorsoventrally compressed in the midgut region. In fixed condition the colour is of an overall bluish-brown, the dorsal side a little bit darker than the ventral side. The horizontal lateral cephalic slits are rather shallow, reaching back only to the openings of the cerebral organs. There is no caudal cirrus.

**Epidermis:** The epidermis shows no special characters and rests on the distal basement layer (sensu SENZ 1992) which is slender, such as the proximal basement layer (sensu SENZ 1992).

**Body wall musculature and dermis:** In the foregut area the dermis occupies about one third of the space between the epidermis and the outer circular muscle layer of the body wall (Fig. 2.). In the midgut area the dermis and the proximal outer longitudinal muscle layer (for terminology see SENZ 1992) are reduced and some of the dermal glands extend to the proximal basement layer. No gelatinous layer is present (Fig. 2.). The dermal glands resemble the condition in *Cerebratulus niveus* (PUNNETT, 1903). They are relatively densely packed, although there are longitudinal muscle fibers elaborated between them. Subepidermal circular muscle fibers are present.

The "Zentralzylinder" of the preseptal area is only weakly developed, especially its longitudinal muscle layer. Several circular muscle fibers spread away from the "Zentralzylinder" into the outer longitudinal muscle layer. In front of the septum both muscle layers of the "Zentralzylinder" become reduced in thickness. Simultaneously, the circular muscle layer becomes gradually dispersed. Thus, the anterior margin of the brain lies in a wickerwork of more or less tangentially orientated circular muscle fibers. Behind the dorsal commissure of the brain, a compact dorsal arch of the outer circular muscle layer arises, resting on a comparatively well developed arch of the longitudinal muscle layer. Behind the

ventral commissure of the brain, which reaches much further back than the dorsal commissure, the ventral arch of the circular muscle layer becomes better developed between the ventral ganglia. Here, as in front of the brain, the circular muscle layer represents a loose wickerwork of muscle fibers. Towards the buccal chamber both arches become broader until they fuse laterally. The cerebral organs lie proximally to the dorsal arch, whereas the longitudinal nerve cords rest on the distal side of the ventral arch.

Furthermore, the midpart of the ventral muscle-arch becomes disarranged because of the emerging buccal chamber. Some of the muscle fibers of the ventral part of the circular muscle layer rest on the roof of the buccal chamber. These fibers come into close contact with the posterior projection of the horizontal muscle fibers of the brain region. Backwardly both groups of fibers build an uniform transverse muscle plate. Laterally to the buccal chamber this muscle plate passes through the inner muscle layers of the body wall. The lateral parts of the plate (positioned between the branches of the forking lateral blood vessels) have to be defined as the most anterior radial muscles of the foregut muscle system. Thus, the entire muscle plate represents the anterior ending of the foregut muscle system.

The only rudiments of the inner circular muscle layer present in the specimens are the above mentioned horizontal muscle fibers of the brain area and the dorsoventral muscles of the midgut-area. The horizontal muscle is weakly developed, becoming somewhat stronger in thickness behind the ventral commissure of the vascular apparatus. One of the specimens has only slightly developed ovaries. The dorsoventral muscles of this specimen are slightly developed too. The other specimen has much better developed ovaries and dorsoventral muscles.

**Mesenchyma:** The structure and distribution of the mesenchyma is rather uniform in *Micrura*. In the present material both characters correspond to the condition typical in micruran heteronemerteans.

**Cephalic gland:** The cephalic gland is well developed. It is restricted to the preseptal area.

**Proboscis apparatus:** The rhynchodaeum opens from the subterminal proboscis pore. It is lined by a glandular epithelium. The rhynchodaeal musculature is simply developed and a sphincter is wanting. The septum is much reduced. The rhynchocoel extends almost to the posterior end of the body and shows no special characteristics. Its muscle layers are not interwoven with the muscle layers of the body wall.

The proboscis is well developed and comprises two regions. Region 1 (adjacent to the insertion) is rather short and includes the endothelial layer, the longitudinal muscle layer, two proboscis nerves and the epithelium. Region 2 (reaching back to the retractor muscle) consists of the same layers as region 1 but complemented, by a circular muscle layer, lying between the epithelium and the longitudinal muscle layer. Instead of two nerves a nervous plexus (= neural sheath) is present. Two muscle crosses are present between the circular muscle layers. No rhabdit-like structures occur in the epithelium.

**Alimentary tract:** The buccal chamber lies immediately behind the cerebral organs. It possesses subepithelial glands from its beginning, as does the foregut. In the foregut these glands are restricted to its ventral wall. Nevertheless, the ventral wall is not very thick, becoming even more reduced in thickness backwards. The rather weakly developed foregut musculature consists of circular muscles lying either at the border of the foregut, or among the subepithelial glands. The foregut muscles are restricted to those areas, where either the foregut plexus of the vascular apparatus and/or subepithelial gland cells are present.

The transition of the foregut into the midgut is not continuous, since the midgut projects somewhat into the foregut lumen (Fig. 1.). Here the foregut circular muscles are more in number than in front of it. This is also true for the mesenchyma lying adjacent to the lateral parts of the digestive apparatus. The midgut is rather simple in construction. The size of the midgut lateral diverticula is correlated with the degree of the differentiation of the gonadal sacs.

**Vascular apparatus:** The dorsal commissure of the vascular apparatus extends far back (not continuously) from the tip of the head. Thus, no cephalic loop is present. Behind the brain the ventral commissure is formed and the vascular apparatus becomes U-shaped in cross section. In the more posterior part of the brain area the horizontal muscle emerges and separates the commissure from the lateral vessels (not continuously). Just in front of the cerebral organs proper the lateral vessels extend dorsally between the dorsal ganglia and the rhynchocoel. Thus, they surround the dorsal ganglia at their median and dorsal sides. Backwardly the lateral parts of the lateral vessels terminate; simultaneously, the ventral commissure extends laterally. Thus, it comes into close contact with the ventral margin of the cerebral organs. Behind the cerebral organs the ventral commissure and the lateral vessels unite again for a short distance. Furthermore, the dorsally extending buccal chamber divides the whole vessel complex midventrally. Thus, two big lateral vessels emerge. At the anterior margin of the buccal chamber, both lateral vessels split at several places and give rise to the foregut vascular plexus. This plexus is well developed and reaches back to the posterior end of the foregut (Figs. 1, 2).

The dorsal vessel emerges from the ventral commissure. A short distance behind its origin, the dorsal vessel rises against the rhynchocoel.

**Nervous system:** The brain is rather well developed. The outer neurilemma is as in other micruran species indistinct. The inner neurilemma is weakly developed. The dorsal commissure lies at the anterior margin of the brain, in front of the thick ventral commissure. The dorsal ganglia are somewhat bigger than the ventral ganglia, and forked at their hind ends. The small dorsal part of each dorsal ganglion terminates at the anterior margin of the cerebral organs proper. At their beginning the lateral nerve cords lead in a sharp turn into a lateral position, which they maintain to the posterior end of the body. The lateral nerve cords show no characters of importance. Giant nerve fibers are wanting.

The dorsal nerve lies within the nervous plexus of the body wall. It is well developed and takes its origin from the dorsal commissure of the brain.

The foregut nerves emerge from the median side of the beginning lateral nerve cords. In front of and behind the buccal chamber, both nerves are interconnected by thick commissures. Behind the postoral commissure none of the foregut nerves can be further distinguished.

**Cephalic slits and sensory structures:** In front of the brain the horizontal lateral cephalic slits are rather shallow and of simple construction. Their epithelium possesses no gland cells, but slender cylindrical cells mostly ciliated. These cilia are longer than those of the adjoining epidermis. Just in front of the brain the cephalic slits become deeper, thus extending to the brain. There posterior endings, the median part of each slit becomes enlarged. The cerebral organ canals open into these widenings. The slits are not prolonged. The ventral part of each dorsal ganglion transforms into the ganglionic part of the cerebral organs. The glandular part of each organ proper is smaller than the ganglionic part. Each cerebral organ is in close contact with the vascular apparatus.

**Ocelli** are present, but only few in number. A small frontal organ exists at the tip of the head. It consists of three canals comparable to the frontal organ of many other lineid and cerebratulid heteronemerteans (BÜRGER 1895, GIBSON 1985).

**Excretory apparatus:** It is only weakly developed (Fig. 2.), although it extends through the whole foregut region. It is restricted to the dorsal part of the foregut vascular plexus. The efferent ducts resemble slender tubules, running to the surface of the body somewhat above the lateral nerve cords. One of the specimens has three efferent ducts on one side and four on the other. The second specimen has two and three ducts respectively.

**Reproductive apparatus:** The reproductive apparatus shows no special characters. Gonoducts not present in the present material.

#### Discussion:

As pointed out above, the genus *Micrura* is far from being well defined. Thus, the identification of the material as being a member of this genus can only be provisional.

The following characters are typical for the genus *Micrura*: (a) Head with two horizontal lateral cephalic slits, (b) rhynchocoel muscle layers not interwoven with the body wall muscle layer, (c) proboscis with an outer circular and an inner longitudinal muscle layer (see GIBSON 1985a), (d) foregut musculature with circular muscle fibers, (e) absence of giant nerve fibers, (f) foregut with vascular plexus and subepithelial gland cells, (g) with outer neurilemma of the brain indistinct and only weakly developed, and (h) only a rudimentary ventral muscle plate.

The material can be distinguished from any hitherto described species of this genus by the following specific character-combination: (a) Ocelli and frontal organ present, (b) efferent ducts of the excretory apparatus few in number but more than one pair, (c) presence of a weak horizontal muscle plate in the brain region (see FRIEDRICH, 1960, for this item), (d) caudal cirrus absent, (e) dermis without connective tissue layer but with longitudinal muscle fibers, (f) head slits not prolonged, and (g) rhynchocoel extending to the posterior end of the body.

*Micrura pseudovaricolor* spec. nov. corresponds in several characters with *M. varicolor*, found in scandinavian waters (PUNNETT 1903, CANTELL 1975). But there are important differences between both species, including the number of efferent ducts of the excretory apparatus, the size of the cephalic gland, the presence of the frontal organ, the mouth area being overlapped or not by the cerebral organs, the dermis with or without longitudinal muscle fibers and the thickness of the dermis. PUNNETT (1903) does not record whether *M. varicolor* possesses a horizontal muscle plate and a ventral longitudinal muscle plate. Furthermore, it is not clear whether *M. varicolor* possesses a caudal cirrus or not (PUNNETT 1903, CANTELL 1975).

From the studied area two more specimens were collected and examined. Both individuals are only a few millimetres long and of pure white colour in fixed condition. Their anatomy shows a striking similarity with *M. pseudovaricolor* spec. nov., but there are also differences: (a) the cerebral organs overlap the buccal chamber, (b) the horizontal muscle plate is wanting, (c) the ventral arch of the outer circular muscle layers in front of the buccal chamber is only weakly developed such as the foregut musculature. Furthermore, one of the two specimens has dorsal ganglia which partly overlap the cerebral organs. Both specimens show no signs of the reproductive apparatus. Thus, they might be thought to be juveniles of *M. pseudovaricolor* spec. nov.. For a definitive solution more material is needed.

## 2. *Micrura elegans* spec. nov.

**Material:** Holotype: immature individual; complete series of cross sections; NHMW: 3227. Paratype: immature individual, complete series of cross sections; NHMW: 3228.

**Type locality:** Scilly Islands (Cornwall; England)

**Diagnosis:** One pair of shallow horizontal lateral cephalic slits occurs, which are not prolonged. Position of the buccal chamber far behind the brain – cerebral organ complex. Dermis without connective tissue layer. The rhynchocoel does not extend to the posterior end of the body. The proboscis possesses an outer circular and inner longitudinal muscle layer. Muscle cross overs are wanting. A frontal organ and two pairs of large ocelli are present. Excretory apparatus with more than one pair of efferent ducts. A caudal cirrus is wanting. The vascular apparatus possesses a cephalic loop.

### **Description:**

**External characters:** In fixed condition the specimens measure approximately 10 mm. The foregut area is cylindrical in cross section and the midgut area gradually flattens posteriorly. The specimens are light-brown on the dorsal surface of the head and in the anterior foregut area. The remaining dorsal body and the margins of the anterior body are white. One pair of horizontal lateral cephalic slits exists. The caudal cirrus is wanting.

**Epidermis:** The epidermis shows no special characters.

**Body wall musculature and dermis:** The dermis is well developed. Some of the dermal glands pass through the proximal outer

longitudinal muscle layer (sensu SENZ 1992) to the proximal basement layer, but none of these glands penetrates the whole body wall, as in *Lineus lacteus* (BÜRGER 1895, pers. obs.). The proximal outer longitudinal muscle layer is thin and the density of its muscle fibers is rather low. Nevertheless, fibers of this muscle layer occur between the dermal glands and even adjacent to the distal basement layer (subepidermal musculature). The thickness of the epidermis in relation to the outer longitudinal muscle layer (sensu SENZ 1992) is 1:2.

Both muscle layers of the "Zentralzylinder" are weakly developed and only few circular muscle fibers spread away from the "Zentralzylinder" into the outer longitudinal muscle layer. In the brain area, the longitudinal and circular muscle layers of the body wall are almost completely reduced. Both layers, however, become stronger in the cerebral organ area. In the remaining body, they are fairly well developed.

The only rudiments of the inner circular muscle layer present in the specimens are a few horizontal muscle fibers in the brain area. This horizontal muscle plate does not extend to the buccal chamber posteriorly. Dorsoventral muscles are wanting in the area between the cerebral organs and the buccal chamber (but are present in *L. lacteus*, another heteronemertean species with the buccal chamber positioned far behind the brain, pers. obs.). Dorsoventral muscles are also wanting in the midgut area. Both specimens are immature. Maybe, there are dorsoventral muscles when gonadal sacs are developed.

The ventral longitudinal muscle plate is wanting.

**Mesenchyma:** It is arranged in a way typical for micruran heteronemerteans. No accumulations of this tissue appear in the area between the brain and the buccal chamber, in contrast to *L. lacteus* (pers. obs.).

**Cephalic gland:** In the preseptal area the outer longitudinal muscle layer is mostly displaced by the cephalic gland. This gland is well developed, forming a dorsal and ventral plate. The cephalic gland cells are of the same type as several dermal gland cells in the postseptal area.

**Proboscis apparatus:** The rhynchodaeum opens from the subterminal proboscis pore and forms a tubular chamber. Its lining epithelium is flattened and its musculature is only weakly developed. No rhynchodaeal sphincter is present. The septum lies in front of the brain. The comparatively narrow rhynchocoel does not extend to the posterior part of the body. Its muscle layers are not interwoven with the body wall musculature. The proboscis is a slender structure and has the same muscle layers as described for *M. pseudovaricolor* spec. nov.. Muscle cross overs are wanting.

**Alimentary tract:** The buccal chamber lies far behind the cerebral organs (Fig. 3). The foregut is voluminous and its ventral wall is well supplied by subepithelial gland cells, first of all in the anterior foregut area. The dorsal foregut epithelium is significantly thinner. Nevertheless, in general the foregut wall is nowhere particularly thick. The foregut muscles are only weakly developed. This is also true for the radial muscles (passing from the body wall to the foregut) of the foregut musculature.

The transition of the foregut into the midgut is continuous. The midgut is spacious. Lateral midgut diverticula are missing from the present specimens.

**Vascular apparatus:** The vascular apparatus is of a simple construction, including a cephalic loop in the preseptal area. In the brain area both lateral vessels are interconnected by a ventral commissure (U-shaped vessel). The horizontal muscle plate separates the lateral vessels from the commissure. Behind the brain only the lateral vessels exist. In the anterior foregut area a simple foregut plexus is established.

The dorsal vessel takes its origin from the ventral commissure in the brain area. Immediately behind its origin it rises up against the rhynchocoel.

**Nervous system:** The brain is large. Its outer neurilemma is almost completely reduced. The well developed dorsal commissure lies in front of the ventral commissure. The latter cannot be distinguished clearly from the ventral ganglia. The dorsal ganglia are much larger than the ventral ones. The relatively large dorsal branch of each dorsal ganglion extends posteriorly just behind the anterior end of the cerebral organs.

The lateral nerve cords emerge from the posterior margins of the ventral ganglia. Behind their origin they lead in a wide turn into a lateral position which they maintain to the posterior end of the body. In the area between the cerebral organs and the buccal chamber, they possess a strikingly wide diameter (Fig. 3). No giant nerve cells exist.

One pair of foregut nerves runs posteriorly from the median sides of the posterior endings of the ventral ganglia. Somewhat behind their stem area they can no longer be distinguished from the body wall neural sheath in which they are embedded. Posteriorly, just in front of the buccal chamber, a strong unpaired foregut nerve appears (Fig. 3). Behind its anterior origin this nerve divides. Both branches pass alongside the lateral walls of the buccal chamber to the foregut.

The dorsal nerve and the body wall neural sheath are only weakly developed.

**Cephalic slits and sensory structures:** In the preseptal area each horizontal lateral cephalic slit occupies half the distance between the lateral border of the body and the "Zentralzylinder". They are rather simple in construction, and their epithelium lacks gland cells. In the brain area the slits become even more shallow, but nevertheless they extend to the brain. Here the median parts of the slits enlarge. The epithelium of these widenings is extremely thick. The cerebral organ canals open into these enlargements. The cerebral organs proper are well developed. The ventral branch of each dorsal ganglion passes into the appropriate cerebral organ. The posterior portion of each cerebral organ proper projects into the lateral vessels.

The frontal organ consists of three ducts, which occur in the tip of the head.

Two pairs of comparatively large ocelli are positioned in the anterior preseptal area.

**Excretory apparatus:** It extends from the cerebral organs to the posterior end of the foregut, being more or less restricted to the dorsomedian

margins of the vascular foregut plexus. More than one pair of efferent ducts occur, running to the body surface far above the lateral nerve cords.

**Reproductive apparatus:** None of the present specimens possesses signs of the reproductive apparatus.

#### Discussion:

The generic classification depends on the same characters as in *M. pseudovaricolor* spec. nov..

The position of the buccal chamber distinguishes the material studied from any other hitherto described micruran species. Among the heteronemerteans, this character was hitherto only known from *Lineus lacteus*, *Paralineus elisabethae* SCHÜTZ 1911, *Dokonemertes magellanicus* GIBSON, 1985 and *D. macquariensis* GIBSON, 1985 (BÜRGER 1895, SCHÜTZ 1912, GIBSON 1985b). The present material can be distinguished from these heteronemerteans by the different generic diagnosis. Furthermore, both *Dokonemertes* species can be easily separated from the present material by the extraganglionic tissues, known from *Dokonemertes* (GIBSON 1985b), but missing in the present specimens. In *L. lacteus* lobules of the postcerebral part of the cephalic gland penetrate the whole body wall, thus lying partly in the mesenchymatous tissue adjacent to the alimentary tract. Nothing comparable is present in the micruran material. Furthermore, in *L. lacteus* large packages of mesenchymatous tissue are present in the region between the brain and the buccal chamber (pers. obs.). Such packages are missing in the micruran material. *P. elisabethae* can be easily distinguished from the present material by the lateral cephalic furrows which exist in the micruran material but not in *P. elisabethae* (SCHÜTZ 1912). As far as it belongs to the genus *Micrura* itself, the present material can be distinguished from the remaining members of this genus by the character combination listed in the species diagnosis (see above).

### Hoplonemertini HUBRECHT, 1879 – Tetrastemmidae HUBRECHT, 1879

#### Genus *Tetrastemma* EHRENBERG, 1831

Hoplonemertean systematics is a vast area of confusion and most families and genera are only ill defined (GIBSON & MOORE 1985). This is also true for the taxon Tetrastemmidae and its type genus *Tetrastemma* (BERG 1973, NORENBURG 1986).

GIBSON (1982a) proposes the following preliminary diagnosis:

Mostly small slender monostiliferous hoplonemerteans in which the body wall musculature is not strongly developed; eyes usually distinct, mostly four arranged at the corners of a square or rectangle, occasionally fragmented; rhynchocoel extending to or almost to the posterior end of the body, with wall containing two distinct muscle layers; proboscis not strongly developed; frontal organ probably present; cephalic glands usually well developed but rarely extending behind cerebral ganglia; nervous system with neither neurochords nor neurochord cells, without accessory lateral nerve; blood vascular system with three longitudinal vessels, mid-dorsal vessel with one (?) vascular plug; excretory

system restricted to foregut regions, with two or only a few nephridiopores; intestinal caecum present, with anterior diverticula; sexes separate; marine or estuarine.

### 3. *Tetrastemma angulatus* spec. nov.

**Material:** Holotype: mature male; complete series of cross sections. NHMW: 3229. Paratypes: three mature females; complete series of cross sections. NHMW: 3230.

**Type locality:** Scilly Islands (Cornwall, England).

**Diagnosis:** Septum very much reduced; cephalic gland consists of two gland cell types, cells of one of these types occur also in the rhynchodaeal wall; longitudinal nerve cord stem area africanemertes-like (= longitudinal nerve cords not emerging from the posterior endings of the ventral ganglia); pylorus short; no dorsoventral muscles in the midgut area.

#### **Description:**

**External characters:** In fixed condition, the specimens are about 3 mm long and cylindrical in cross section. The head continues directly into the remainder of the body. One pair of shallow longitudinal cephalic furrows is present in the anterior portion of the head. These furrows do not extend to the tip of the head anteriorly. The cerebral organ canals open into the posterior margins of these furrows. The specimens are of an overall white. Two pairs of ocelli exist. These are arranged typically for the genus *Tetrastemma*.

**Epidermis and dermis:** The epidermis and basement layer show no special characters. The epithelium of the cephalic furrows consists of cylindrical, slender cells with cilia, which are longer than the cilia of the adjacent epidermis. No gland cells occur in the epithelium of the furrows. A very rudimentary dermis exists.

**Body wall musculature:** The longitudinal and circular muscle layer of the body wall extend anteriorly to the tip of the head, but are only weakly developed in the preseptal area. Only a few cephalic retractor muscles exist. The longitudinal muscle layer is not divided, although, in the brain area some fibers of the longitudinal muscle layer lie below the proximal border of this layer, because of the large cephalic gland.

Behind the brain area both muscle layers of the body wall are well but not strongly developed. A diagonal muscle layer is wanting.

Only a few dorsoventral muscle fibers are present in the stomach area; they are completely absent in the midgut area.

**Mesenchyma:** It is typical for the genus *Tetrastemma*.

**Cephalic gland:** The cephalic gland is rather large, and reaches posteriorly to the brain. The posterior portion of this gland consists of one dorsal and two smaller ventral lobules. In front of the septum the dorsal lobe possesses the same breadth as the rhynchodaeum on which it rests. At the level of the cerebral organ openings the dorsal lobe becomes successively indistinct. The two ventral lobules remain compact, corresponding to thin crescents situated closely to the

ventrolateral borders of the rhynchodaeum. At the same degree as the rhynchodaeum adopts a more ventral position anteriorly, both lobules adopt a more dorsal position in relation to the rhynchodaeum. At least most of the cephalic gland cells open to the exterior at the tip of the head. A frontal organ is missing. All the above mentioned characters correspond to that part of the cephalic gland which is built up by large, rounded cells containing fine granula (= cell type 1). In the area where the dorsal lobe becomes indistinct, a second type of cephalic gland cells (= cell type 2) occurs, which is intermingled with the type 1 cells. Type 2 cells are smaller and less rounded than type 1 cells, and show a different staining reaction. Type 2 cells are also present in the rhynchodaeal wall.

**Proboscis apparatus:** The rhynchodaeum opens from the subterminal proboscis pore. Its wall is glandular (see above). Rhynchodaeal muscles are present, but no sphincter. The septum is situated just in front of the brain and consists of several slender septal muscle fiber bundles. The rhynchocoel extends the full length of the body. It shows no special characters. The proboscis is well developed and shows no unusual characters for a member of the genus *Tetrastemma*. A retractor muscle is present.

**Alimentary tract:** The esophagus represents a thin tube, lined by a non glandular epithelium. At its anterior end the esophagus opens into the rhynchodaeum. Posteriorly, at the level of the posterior brain margin, it widens into the stomach. The stomach is rather voluminous. Its highly folded and richly glandular epithelium is thick (Fig. 5.). One of the immature females possesses a stomach which is less voluminous and contains only one mid-dorsal longitudinal fold. Stomach diverticula are absent. There is a continuous transition from the stomach into the pylorus. The pyloric tube is short and lined by a thinner and less glandular epithelium than the stomach. The foregut musculature consists of a few longitudinal muscle fibers along side the esophagus and stomach.

Since the pylorus opens into the dorsal wall of the midgut a midgut caecum is present (Fig. 5.). This caecum contains lateral and terminal diverticula. The terminal diverticula extend to the brain. The midgut itself has lateral diverticula, which become less regularly arranged caudad.

**Vascular apparatus:** It consists of a preseptal loop and three postseptal longitudinal vessels. The lateral vessels are situated ventrally to the lateral nerve cords. The stem area of the dorsal vessel could not be determined. The dorsal vessel has one vascular plug.

**Nervous system:** The brain is well developed. Dorsal and ventral ganglia are approximately of the same size. The dorsal commissure is longer than the ventral one. Behind the ventral commissure both ventral ganglia are in close contact with each other, but clearly separated from each other by the thick outer neurilemma of the ganglia.

The lateral nerve cords emerge from the ventral ganglia in a way, comparable to the situation in *Africanemertes* STIASNY-WIJNHOF, 1942 (Fig. 4., STIASNY-WIJNHOF 1942, KIRSTEYER 1965). Nevertheless, the detailed structure of the lateral nerve cord stem area depends also on the contraction of the specimen. Only

one fiber core exists in every lateral nerve cord. Giant nerve cells and nerve cord muscle fibers are wanting.

**Sensory structures:** One pair of well developed cerebral organs is present, just in front of the brain. They somewhat overlap the anterior margin of the brain (degree of contraction). The opening of each cerebral organ canal lies near the anterior border of the organ proper. Two pairs of ocelli are present.

**Excretory apparatus:** It shows no special characters. One pair of efferent ducts occur at the level of the posterior brain area.

**Reproductive apparatus:** The sexes are separate. The gonadal area reaches anteriorly to the level of the stomach. Each ovary contains two well developed eggs and several undifferentiated egg cells at the gonadal wall. In the anterior gonadal area the ovaries are serially arranged, with each ovary overlapping the next one somewhat. Posteriorly the arrangement of the ovaries becomes somewhat irregular. In the male the testes are well developed but contain only slightly developed spermatozoa. The testes have a more ventral position than the ovaries. In addition, consecutive testes do not overlap each other. No gonadal ducts exist in any of the present specimens.

**Discussion:** Since there are two pairs of ocelli, well developed cerebral organs just in front of the brain, lateral nerve cords without an accessory fibrous nerve core, a rhynchocoel which reaches the level of the posterior end of the body, a midgut caecum with terminal diverticula which reach the brain, a body wall musculature which is also present in the preseptal area, the material has to be incorporated into the genus *Tetrastemma*. Nevertheless, since the diagnosis of *Tetrastemma* is rather loose, the placing of the material in this genus can only be provisional.

The character combination, mentioned in the diagnosis given above, demonstrates, that the present material cannot be incorporated in any of the hitherto defined species of the genus.

#### 4. *Tetrastemma cruciatus* spec. nov.

**Material:** Holotype: mature Male; complete series of cross sections. NHMW: 3231. Paratypes: 1 male and 3 females; complete series of cross sections. NHMW: 3232.

**Type locality:** Scilly Islands (Cornwall, England).

**Diagnosis:** Dorsal vessel stems from the right lateral vessel, no ventral commissure of the vascular apparatus present; dorsal vessel without vascular plug; no dermis present, stomach not voluminous, midgut caecum short.

#### **Description:**

**External characters:** In fixed condition the animals are about 2,5 mm long and cylindrical in cross section. The head continues directly into the remainder of the body. A pair of shallow head furrows exists into which the cerebral organ canals open. Together, the furrows form a posteriorly widening dorsal V. The anterior end of this V lies at the level of the anterior pair of ocelli.

**Epidermis and dermis:** The epidermis and basement layer show no special characters. Dermis absent.

**Body wall musculature:** The longitudinal and circular muscle layer of the body wall are present in the preseptal area, but only weakly developed at this level. The same is true for the cephalic retractor muscles. Both muscle layers are, however, well but not strongly developed throughout the remaining body. A diagonal muscle layer could not be detected. The longitudinal muscle layer is not divided. No dorsoventral muscles are present.

**Mesenchyma:** Larger packages of mesenchymatous tissue exist in the preseptal and the esophageal area. In the remaining body it is developed as typical for the genus *Tetrastemma*.

**Cephalic gland:** It resembles that in *T. angulatus* spec. nov., but is slightly smaller than in this species.

**Proboscis apparatus:** The rhynchodaeum opens from the subterminal proboscis pore. The anterior part of the rhynchodaeal tube is lined by a nonglandular and flattened epithelium. Posteriorly the rhynchodaeal epithelium becomes thicker and glandular. The rhynchodaeal musculature consists of longitudinal and circular muscle fibers. A rhynchodaeal muscle sphincter is present. The septum lies in front of the brain and consists of several thin septal muscle bundles. The rhynchocoel extends the full body length. The rhynchocoel and the proboscis show no special characters; they are typically differentiated for the genus *Tetrastemma*. A retractor muscle is present.

**Alimentary tract:** The slender esophagus opens at its anterior end into the rhynchodaeum. Its lining epithelium is flattened. At the level of the posterior brain area, the esophagus widens and continues into the stomach. The stomach is not very voluminous and its wall is only little folded (Fig. 6.). No stomach diverticula are present. Posteriorly the stomach continues into the pylorus. Since the pylorus opens into the dorsal wall of the midgut posteriorly, a midgut caecum is present. This caecum extends forward to the posterior ending of the stomach. It possesses lateral and terminal diverticula. The lateral diverticula are comparable to the diverticula of the midgut itself. The terminal diverticula do not reach the brain. Those specimens with only slightly developed gonadal sacs possess a midgut with shallow diverticula. The midgut diverticula are better developed where the gonadal sacs are larger. One of the males possesses large testes which form one pair of lateral rows. In this case the midgut possesses no diverticula at all and is more or less restricted to its axial tube.

**Vascular apparatus:** It consists of a preseptal loop and three longitudinal vessels. No complete ventral commissure of the vascular apparatus is developed. The dorsal vessel stems from the right lateral vessel in the stomach area. No vascular plug is present. In the postcerebral foregut area the dorsal vessel lies at the right border of the foregut and rhynchocoel wall.

**Nervous system:** The ventral ganglia of the brain are somewhat larger than the dorsal ganglia. The dorsal commissure is well developed and

slightly longer than the ventral one. The longitudinal nerve cords have one fibrous nerve core, no giant nerve cells and no nerve cord muscle fibers.

**Sensory structures:** Two pairs of ocelli exist. The anterior pair lies near the tip of the head. The posterior one is positioned at the level of the cerebral organs. The cerebral organs are well developed and lie in front of the brain. Their structure is typically tetrastemma-like. The cerebral canals open to the exterior far in front of the brain.

**Excretory apparatus:** The collecting tubules of the excretory apparatus possess a rather large diameter and are lined by a thick epithelium. They can reach nearly the same diameter as one of the lateral nerve cords. One pair of excretory ducts is present. The excretory apparatus extends from the posterior brain area to the middle of the stomach area.

**Reproductive apparatus:** The sexes are separate. Anteriorly, the gonadal area reaches into the pyloric region. The position of the gonadal sacs is described above. No gonadal ducts exist in the studied specimens.

**Discussion:** The generic classification depends on the same characters as in the case of *T. angulatus* spec. nov.. But, since the anterior diverticula of the midgut caecum do not reach forward to the brain, the classificatory situation is somewhat problematical. FRIEDRICH (1935a) separated the genera *Tetrastemma* and *Prostomatella* FRIEDRICH, 1935 first of all by the structure of the septum of the proboscis apparatus and the presence of the anterior diverticula of the midgut caecum. Due to these characters, the material has midgut caecum diverticula such as *Tetrastemma*, but without reaching the brain. The proboscis insertion is prostomatella-like. In 1954 CORRÉA described two new species with the same intermediate character combination and placed both species in the genus *Prostomatella* (*P. enteroplecta* CORRÉA, 1954 and *P. merula* CORRÉA, 1954). Subsequently FRIEDRICH (1970) transferred both species into the genus *Tetrastemma*. More recently NORENBURG (1986) included both species in his newly erected genus *Cyanophthalma* gen. et comb. nov.. The remaining species of this genus are *C. (Tetrastemma) obscura* SCHULTZE, 1851 and *C. (Amphiporus) cordiceps* sensu FRIEDRICH, 1933 (NORENBURG 1986). This concept of *Cyanophthalma*, although an interesting systematic attempt, bears a problem in its own. In contrast to *C. obscura*, all of the above mentioned species possess anterior diverticula of the midgut caecum leading forward to the brain, but without reaching it. Since the present material has such anterior diverticula it has to be placed in the genus *Tetrastemma* provisionally, as proposed by FRIEDRICH (1955, 1970). FRIEDRICH (1970: 62): 'CORRÉA gibt solche (elongated anterior intestinal diverticula) für *P. enteroplecta* and *P. merula* aber ausdrücklich an. ... Sie sollten vorläufig zu der Sammelgattung *Tetrastemma* gestellt werden, bis eine eingehende Revision dieser Gattung weitere Klarheit verschafft.' Furthermore, since both species lack an oblique muscle layer in the body wall (CORRÉA 1954, NORENBURG 1986), they even do not fit the generic diagnosis of *Cyanophthalma* in every respect.

The characters listed in the species diagnosis given above demonstrate that the present material belongs to a new species within the genus *Tetrastemma*.

## Hoplonemertini – Prosorhochmidae BÜRGER, 1895

Genus *Oersteddiella* FRIEDRICH, 1935

The following diagnosis of the genus *Oersteddiella* follows suggestions of FRIEDRICH (1935, 1936, 1955), KIRSTEUEER (1963) and GIBSON (1982a):

Marine, mostly small monostiliferous hoplonemertean without cephalic furrows. The body wall muscle layers occupy the preseptal area. The longitudinal muscle layer is not divided. The dorsoventral muscles are wanting in the midgut area, but are present in the stomach area. The lateral nerve cords possess an accessory fibrous nerve core of varying length. No giant nerve fibers or muscle fibers occur in the lateral nerve cords. The dorsal and ventral ganglia of each side are not separated from each other at the lateral borders. The esophagus opens into the rhynchodaeum. The midgut possesses lateral diverticula and a caecum without terminal diverticula. The septum consists of several septal muscles. The cerebral organs possess a simple organization and do not reach the brain posteriorly. There are two pairs of ocelli. Sexes separate.

*5. Oersteddiella crassus spec. nov.*

**Material:** Holotype: immature specimen; complete series of cross sections. NHMW: 3233.

**Type locality:** Scilly Islands (Cornwall, England).

**Diagnosis:** The rhynchocoel extends posteriorly to some 80% of the body length; the posterior section of the proboscis is uniform; the esophagus is present but very short; a stomach dorsoventral musculature is present; the midgut caecum reaches forward near the posterior margin of the brain; the accessory fibrous core of each lateral nerve cord extends beyond the middle of the body, but does not reach to its posterior end; the posterior pair of ocelli lies behind the septal area; the simple cerebral organs are rather long (= not restricted to the anterior head area); the dorsal vessel possesses no vascular plug; a ventral gliding surface is wanting.

**Description:**

**External characters:** In fixed condition, the single specimen measures about 2 mm and is cylindrical in cross section. It is of an overall white colour. No cephalic furrows are present. There is no ventral gliding surface.

**Epidermis and dermis:** The epidermis and epidermal basement layer show no special characters. No dermis is differentiated.

**Body wall musculature:** The longitudinal and circular muscle layer of the body wall are only weakly developed. The circular muscle layer and the distal part of the longitudinal muscle layer continue in front of the septum, but do not reach the very anterior end of the head. The cephalic retractor muscles consist only of a few muscle fibers. These are more or less restricted to the area not occupied by the cephalic gland. The longitudinal muscle layer is not divided. This is also true for the septal area, since the septum is not of the split type, as defined by KIRSTEUEER (1974).

A diagonal muscle layer is probably wanting. There are no dorsoventral muscles, except for a few muscle fibers in the stomach area (see below).

**Mesenchyma:** It is only very sparsely developed. It is mainly restricted to the anterior stomach area, flanking the stomach and posterior brain.

**Cephalic gland:** It extends to the brain posteriorly. At its posterior end this gland envelopes the rhynchodaeum entirely. Anteriorly the gland becomes restricted to the area above the rhynchodaeum. Most of the cephalic gland cells open at the tip of the head, but a frontal organ is not present.

**Proboscis apparatus:** The rhynchodaeum opens from the subterminal proboscis pore. The anterior part of the rhynchodaeum possesses a nonglandular epithelium, but a glandular one is present posteriorly. No muscle fibers line the rhynchodaeum. A rhynchodaeal sphincter is not present. The septum lies in front of the brain, consisting of 10 strong septal muscles. The rhynchocoel extends posteriorly to some 80% of the body length (this character depends on the degree of body contraction too). The rhynchocoel wall contains two distinct and slender muscle layers. The proboscis is well developed, but possesses only weak muscle layers. No distinct proboscis nerves could be detected. The stylet apparatus is comparable to the apparatus in *Oerstedia dorsalis* ABILDGAARD, 1806 (SUNDBERG 1984). There are two accessory stylet pouches, containing up to two accessory stylets. The posterior section of the proboscis is uniformly built.

**Alimentary tract:** The esophagus opens at its anterior end into the rhynchodaeal tube. The esophageal tube is narrow and lined by a thin epithelium. Nearly immediately behind the anterior opening of the esophagus, the foregut epithelium becomes thicker and glandular. The diameter of the foregut increases in this area. Thus, the esophagus is very short and only very slightly formed. The transition from the esophagus into the stomach takes place at the anterior margin of the brain. The stomach itself is rather simple constructed and not voluminous. There are no stomach diverticula. In the stomach area a few dorsoventral muscle fibers occur. The course of these fibers is comparable to those of the stomach area in *Oerstediella similiformis* FRIEDRICH, 1935 (FRIEDRICH 1935). Posteriorly the stomach continues into the pyloric tube. The stomach and the pyloric tube are nearly of the same length. The pyloric tube corresponds to a simple longitudinal tube, entering the dorsal wall of the midgut at its posterior end. The wall lining the pyloric tube is less glandular and thicker than the stomach epithelium. The midgut caecum extends to the brain anteriorly. The caecum contains two pairs of lateral diverticula, but no terminal diverticula. The midgut itself contains only shallow lateral diverticula. The specimen is immature and the midgut diverticula are, maybe, deeper when gonadal sacs are developed.

**Vascular apparatus:** It consists of a cephalic loop and three postseptal longitudinal vessels. The stem area of the dorsal vessel could not be detected. No vascular plug is developed.

**Nervous system:** The brain is relatively large. The dorsal and the ventral ganglia are of the same size. Both ganglia of each side of the body cannot be distinguished from each other at the lateral borders of the brain. The weakly

developed dorsal commissure is longer than the ventral commissure. The dorsal ganglia are forked in their posterior area. The ventral branch of each dorsal ganglion is rather small. They protrude into the lateral nerve cords, forming the accessory fibrous cores (Fig. 8.). The accessory fibrous core of each lateral nerve cord is much smaller than the fibrous core emerging from the ventral ganglion (Fig. 7.). Posteriorly, both fibrous cores unite at several places. Each accessory fibrous core reaches beyond the middle of the body, but ends well before the hind end of the body. Giant nerve cells and nerve cord muscle fibers are wanting.

**Sensory structures:** Two pairs of relatively small ocelli are present. The posterior pair is placed behind the septum at the lateral borders of the brain. A similar situation is known from *Paroerstedtia laminariae* FRIEDRICH, 1936 (FRIEDRICH 1936). The anterior pair of ocelli lies at the level of the posterior endings of the cerebral organs. The cerebral organs itself are rather simply constructed but relatively long. Thus, they are not restricted to the anterior tip of the head, but do not reach the brain posteriorly. The cerebral organ canals open somewhat behind the tip of the head.

**Excretory apparatus:** Could not be discerned.

**Reproductive system:** The specimen is immature and no signs of the reproductive apparatus are present.

**Discussion:** Because of the two pairs of ocelli, the relatively simple cerebral organs (posteriorly not reaching the brain), the accessory fibrous nerve core, the absence of dorsoventral muscles in the midgut area, cephalic furrows and terminal diverticula of the midgut caecum, the large cephalic gland and the septum made of several septal muscles, the studied material has to be incorporated into the genus group *Oerstedtia* (valid species: *O. dorsalis* ABILDGAARD, 1806, *O. striata* SUNDBERG, 1866), *Oerstedtiella* (valid species: *O. similiformis* FRIEDRICH, 1935, *Oe. tenuicollis* KIRSTEYER, 1963) and *Paroerstedtia* [valid species: *P. wijnhoffi* (FRIEDRICH, 1935), *P. laminariae* (FRIEDRICH, 1936), *P. nigrimaculata* GIBSON 1988].

Since there are muscle fibers at the level of the stomach with a derived course, as well as cephalic retractor muscles and a midgut caecum without terminal diverticula, the specimen has to be placed in the genus *Oerstedtiella*. From the remaining two species of this genus it can be distinguished on the ground of the character combination presented in the diagnosis given above.

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# Plate explanations

## Plate 1

Figure 1: *Micrura pseudovaricolor* spec. nov.: Transverse section through the discontinuous transition of the foregut into the midgut. Scale bar: 0,2 mm.

Figure 2: *M. pseudovaricolor* spec. nov.: Transverse section through the foregut area to show the foregut vascular plexus. Scale bar: 0,2 mm.

Figure 3: *M. elegans* spec. nov.: Transverse section through the area between the cerebral organs and the buccal chamber. Scale bar: 0,1 mm.

Figure 4: *Tetrastemma angulatus* spec. nov.: Transverse section through the brain area, to show the stem area of the lateral nerve cord. Scale bar: 0,2 mm.

Figure 5: *T. angulatus* spec. nov.: Transverse section through the stomach area. Scale bar: 0,2 mm.

Figure 6: *T. cruciatus* spec. nov.: Transverse section through the stomach area. Scale bar: 0,1 mm.

Figure 7: *Oerstedtiella crassus* spec. nov.: Transverse section through the brain area, to show the origin of the accessory nerve core. Scale bar: 0,05 mm.

Figure 8: *O. crassus* spec. nov.: Transverse section through the midgut area. Scale bar: 0,1 mm.

## Abbreviations used in figures:

aln	anterior portion of the lateral nerve cord,
an	accessory nerve core,
cm	circular muscle layer of the body wall,
cu	dermis,
dc	diverticulum of the midgut caecum,
dg	dorsal ganglion,
dv	dorsal vessel,
e	epidermis,
ed	excretory duct,
fg	foregut,
fvp	foregut vascular plexus,
lm	longitudinal muscle layer of the body wall,
ln	lateral nerve cord,
mg	midgut,
mgc	midgut caecum,
olm	outer longitudinal muscle layer,
p	proboscis,
pn	foregut nerve cord,
rc	rhynchocoel,
vc	ventral commissure of the brain,
vp	vascular plexus.

